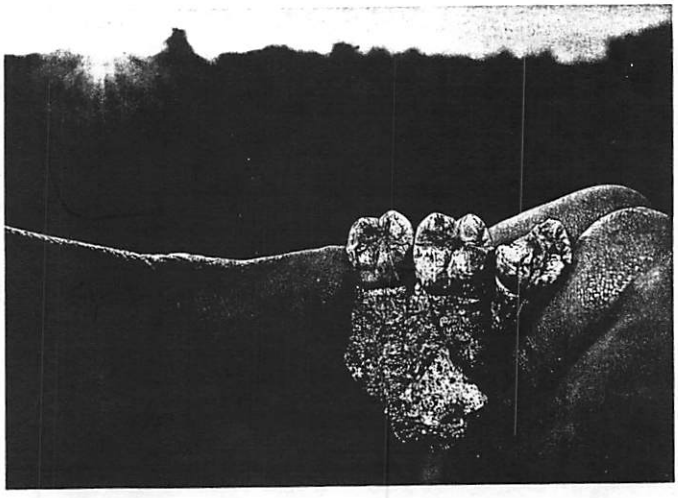
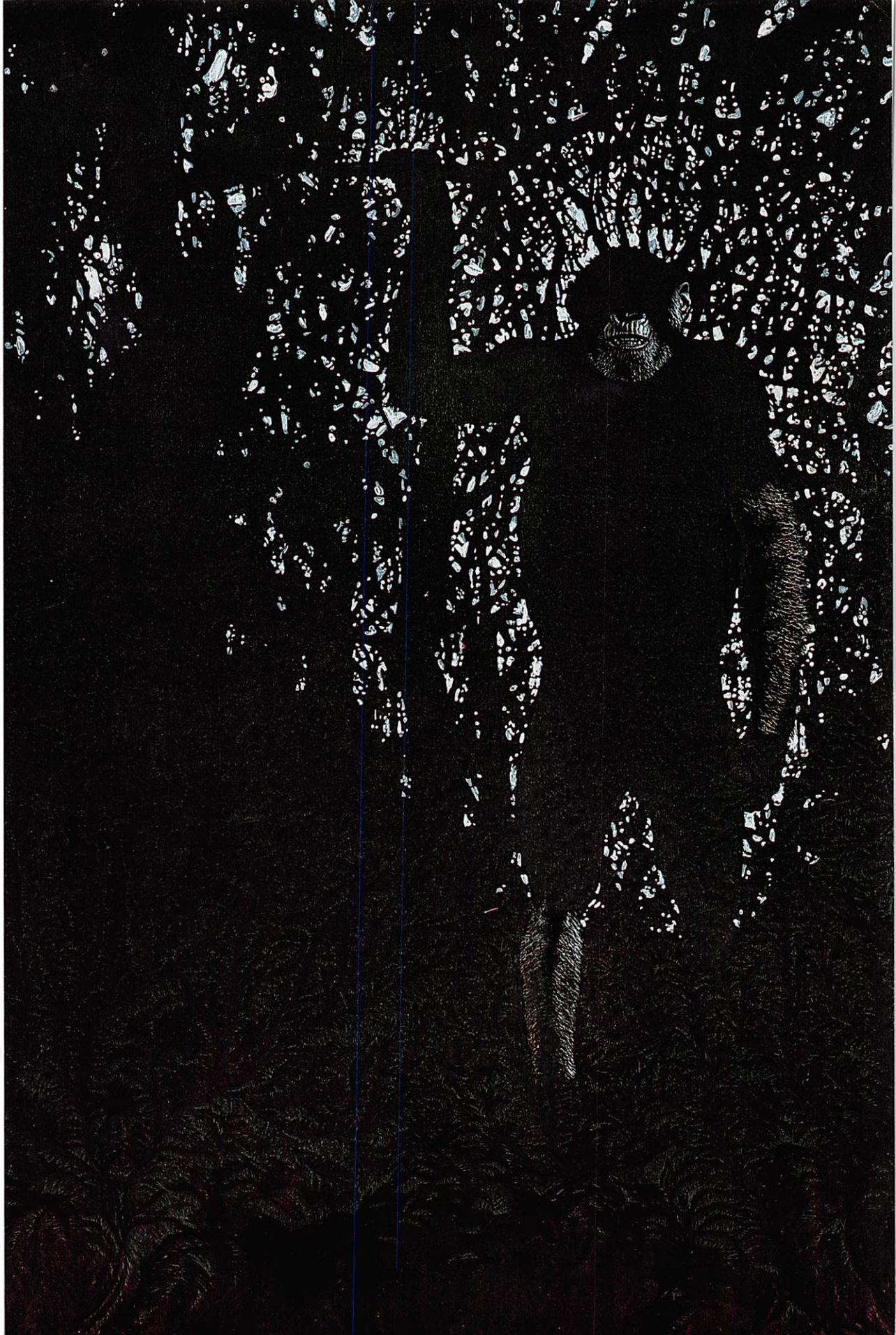
Prehistoric

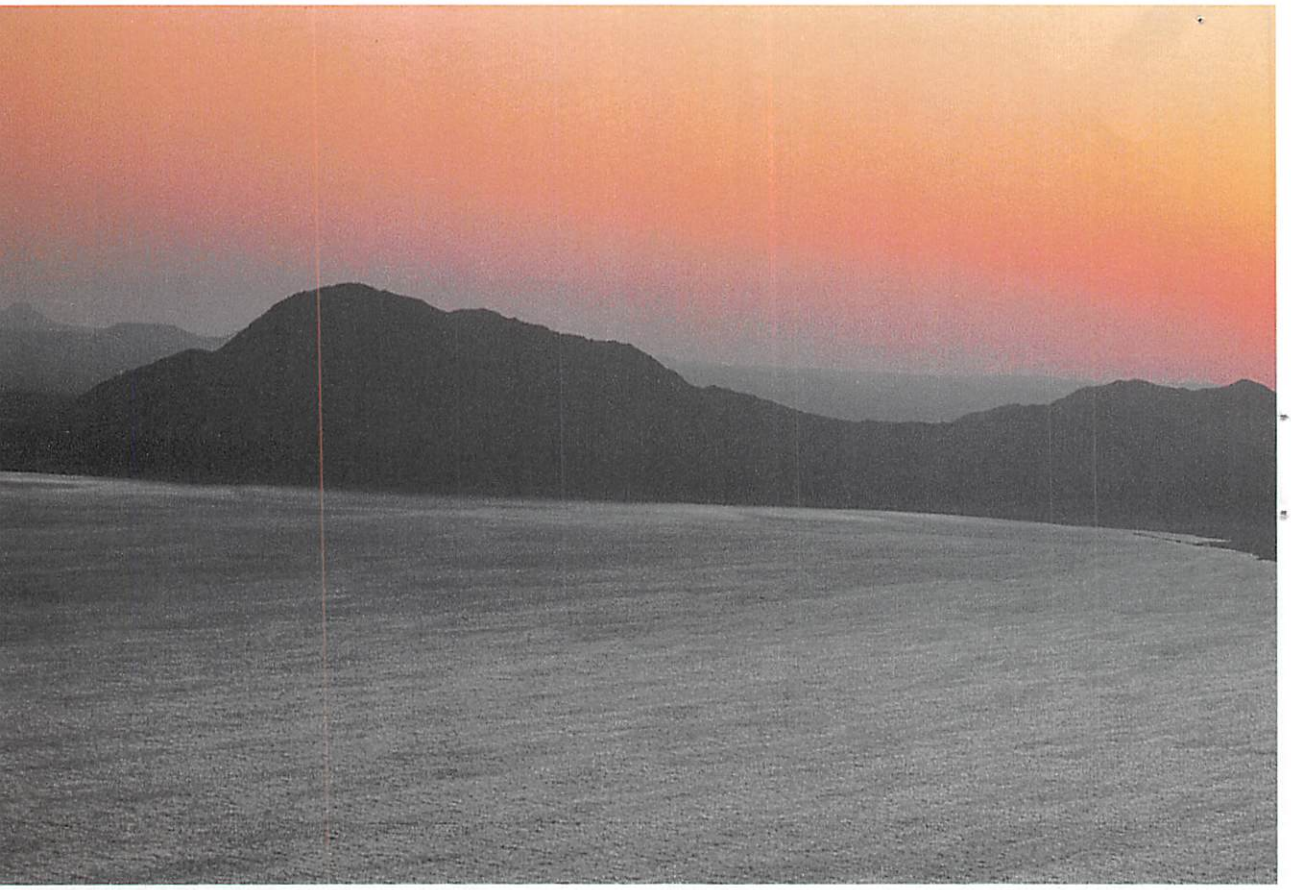
The Farthest Horizon

Messengers from four million years ago, fossils recently exhumed from East Africa's Lake Turkana region are helping scientists etch a portrait of a species on the cusp between apes and humans. Highlighting the latest discoveries of limb and skull fragments, artist John Gurche roughed out a "transitional" hominid with many apelike features. This is a small-brained, bipedal creature, whose upright posture was the hallmark of the first creatures on the human family tree. Larger brains and more intelligence would come later, with the emergence of the genus *Homo* about two million years ago.



By MEAVE LEAKEY
Photographs by KENNETH GARRETT
Art by JOHN GURCHE





"SURELY this is where we came from," Kamoya almost whispered as he gazed in awe at three strange-looking teeth that he held delicately in his hands. I knew exactly what he meant. Looking very apelike, but at the same time vaguely human, the teeth had come from sediments four million years old at a place called Kanapoi in northern Kenya. That made them significantly older than the most ancient evidence of the human lineage then known. Were the teeth from a new species? If so, could they have belonged to humanity's earliest ancestor? Such questions raced through my mind.

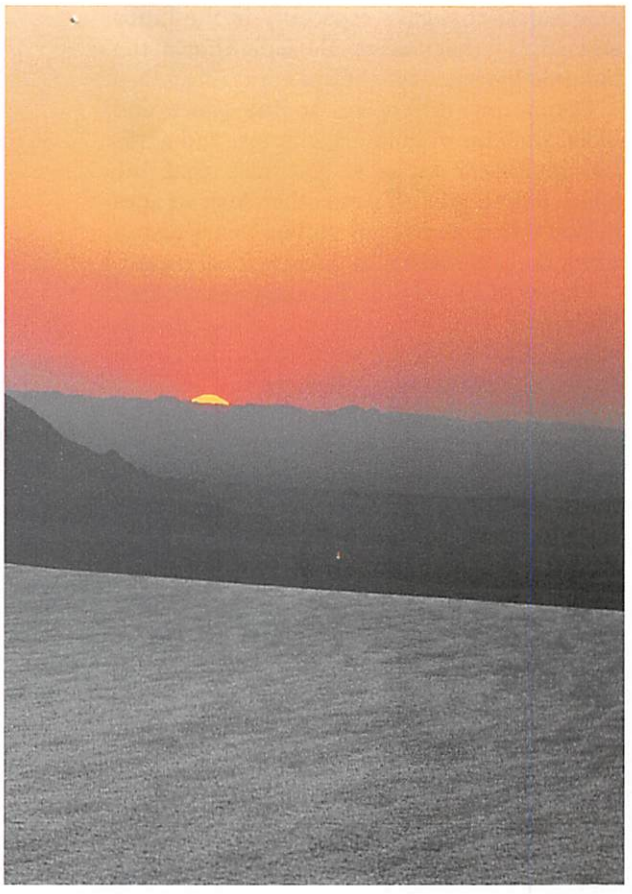
When our associate Peter Nzube Mutiwa found the teeth a few days earlier, I was back in Nairobi, tending to commitments as head of the paleontology department at the National Museums of Kenya. Then Kamoya called me on the radio telephone. Kamoya Kimeu leads the museums' team of fossil hunters we call the Hominid Gang. Hominids are the animals on the human family tree—ourselves and all our ancestors or close relatives since we diverged from the apes—and over the past three decades Kamoya's men have unearthed some of the most important specimens.

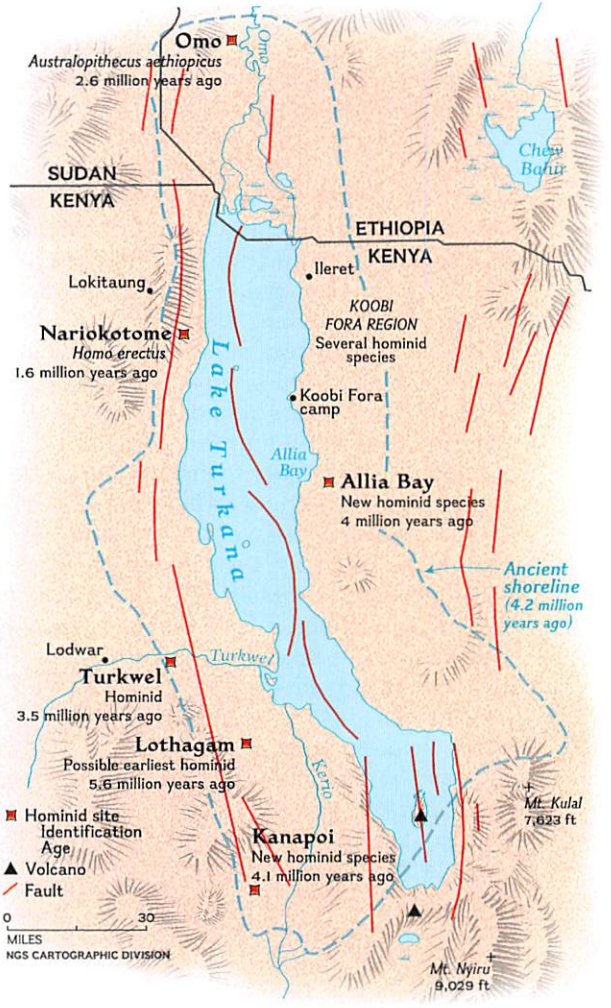
"We have something for you," Kamoya had said.

I made the daylong drive back to Kanapoi as quickly as the rutted roads and tracks allowed. After I congratulated Nzube, who had discovered the teeth among a carpet of lava pebbles, we began planning how to recover more. We marked out a large area and removed the bigger stones. Then we passed the loose soil and smaller rocks through a sieve.

Gradually we collected an almost complete

MEAVE LEAKEY met her husband, Richard—the son and protégé of famed fossil hunters Louis and Mary Leakey—when she joined the Hominid Gang at Koobi Fora as a young zoologist in 1969. KENNETH GARRETT has photographed archaeological sites from Mesoamerica to the Alps for the GEOGRAPHIC. Denver artist JOHN GURCHE, who specializes in reconstructions based on bare bones, brought dinosaurs to life for the January 1993 issue.





set of this mysterious animal's lower teeth, in all but perfect condition. We also found tooth fragments from another individual. My hunch that Kanapoi would produce some remarkably early hominids seemed to be right.

The site lies about 30 miles southwest of Lake Turkana, an immense jade green inland sea. Although crocodiles bask on the lakeshore, the Turkana Basin quickly turns to desert as one travels inland. The earth here bakes all year in heat well above a hundred degrees.

Yet I feel at home. Since 1969 I have worked in the Turkana Basin with teams led by my husband, Richard Leakey, a paleoanthropologist. Almost certainly our first apelike ancestors emerged in Africa, and few places offer as rich a fossil record as this region. Tectonic activity has uplifted ancient sediments, exposing to rapid erosion the soils in which the early hominids' bones were fossilized. Thus each rainstorm can bring new fossils to light. In addition, volcanism over the eons has deposited many layers of ash. Radioactive minerals in the ash decay at known rates, letting us

The cradle of humankind

From the latest finds at Kanapoi to *Homo* remains at Nariokotome and elsewhere, the Turkana Basin harbors a remarkable 4.1-million-year record of hominid evolution. Lined with volcanic hills, Lake Turkana lies at the heart of the East African Rift, the most fertile ground on earth for hominid fossils. At times over the ages the lake has dried up and then swelled to great size, as it did four to five million years ago.

date each layer and the fossils in between.

In recent years Richard has become deeply involved in wildlife conservation in Africa, so I have taken over the coordination of our research in the Turkana Basin, much of which has been supported by the National Geographic Society. Richard's expeditions had mostly focused on the period between one and three million years ago, when our ancestors developed larger brains. Increasing brain size led to the emergence of our genus, *Homo,* and eventually our species, *Homo sapiens.* The Turkana Basin offers abundant sediments of the right age for revealing that process.

It also contains older sediments, and in the late 1980s I decided to search for the more ancient and elusive fossils of the first hominids.

Until the 1994 season scientists had only the scantiest evidence for hominids older than 3.6 million years. Our earliest known ancestor was a short, apelike creature called *Australopithecus afarensis,* whose most famous representative is Lucy, a partial female skeleton discovered by Donald Johanson in 1974 at Hadar in Ethiopia.*

Lucy had long arms like an ape, but her pelvic and leg bones indicate that she walked on two legs. She lived about 3.18 million years ago, yet we know she had older relatives. Footprints left in volcanic ash by three earlier members of her species were found by my mother-in-law, Mary Leakey, at Laetoli in Tanzania in 1978. They have been dated to 3.56 million years ago.

Hominids and African apes share a common ancestor. No one knows what that animal looked like, but we can guess that, like our closest living relatives, chimpanzees and gorillas, it lived in forests and moved through the trees, swinging from its arms and climbing on all fours. At some point one group of those ancestors took the critical first step on the road to modern humans: They began developing the habit of walking on two legs. We do not know why they became bipedal, but over time that adaptation required such profound anatomical changes—especially in the limbs and pelvis—that it marks the separation of the hominid lineage from the apes.

Comparing differences in the genes and blood proteins of humans, chimps, and gorillas, molecular biologists estimate that the hominid line split off from other African apes between five and seven million years ago, a time poorly known in the African fossil record.

I knew of a site in the Turkana Basin called Lothagam that held sediments of exactly this age. In 1967 an American team led by Bryan Patterson recovered a fragment of a possibly hominid mandible from there (right, at left).

I had often flown over Lothagam and gazed at its red rocks, standing out like an island in the desert. Long ago a great river meandered through this land, making it green and lush. Woodlands along the river supported elephants, two rhino species, many pigs, giraffes, antelopes, three different horse species, and multiple carnivores, including large saber-toothed cats.

Unfortunately, in five years of collecting abundant animal fossils we found only two possibly hominid teeth. I had to conclude that our ancestors between five and seven million years ago preferred a more forested environment.

I decided to move to slightly younger sites, with four- to five-million-year-old sediments. That in itself posed problems. For much of that time a lake far bigger than today's Lake Turkana filled most of the basin, yielding crocodile, fish, and turtle fossils but few terrestrial animals. But I knew from Rutgers University geologist Craig Feibel that Kanapoi, submerged 4.2 million years ago, was exposed by the fluctuating lake level during the following 200,000 or so years. Moreover, Patterson's team had found a fragment of a hominid arm bone there. There was also Allia Bay, a slightly younger site with sediments deposited along a river after the great lake began to recede.

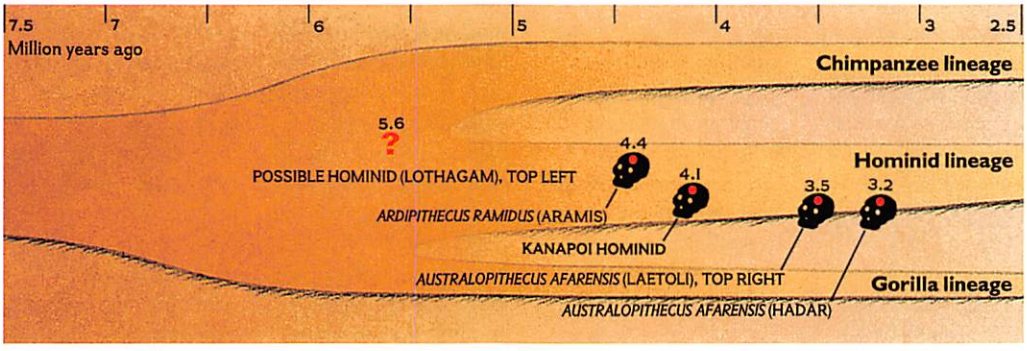
I would work Kanapoi first. During the cool evenings the team sat together in camp and speculated what our first hominid fossil would be. An isolated tooth? Perhaps a jaw? Better still, a leg bone? *(Continued on page 48)*

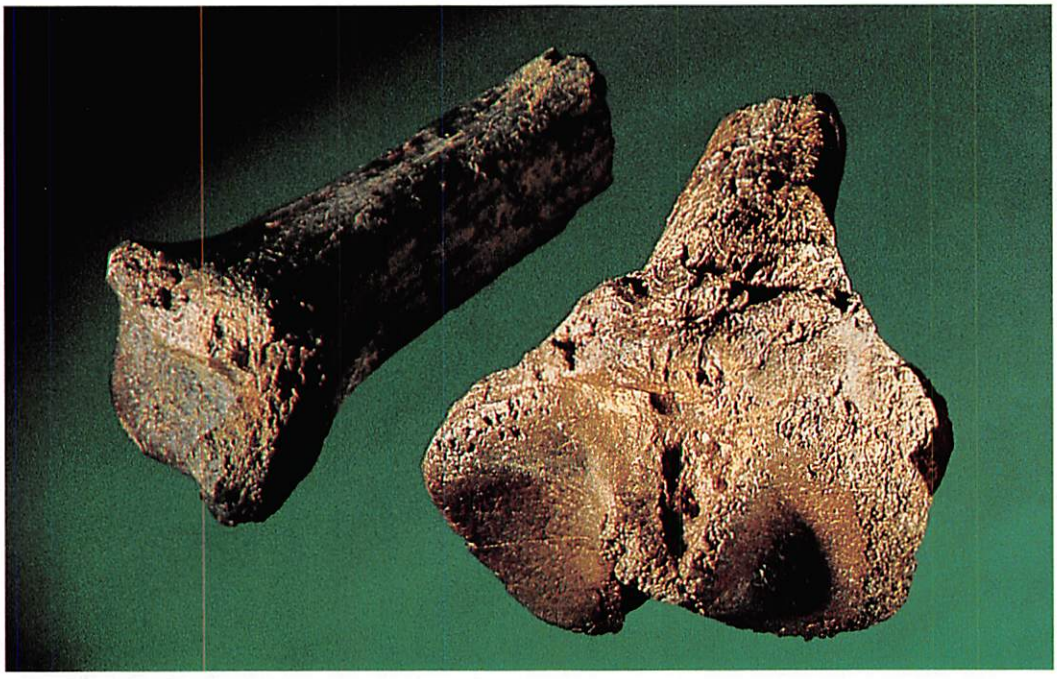
Future articles in this series will focus on early members of our own genus and the hominids that preceded them. Much of this research was supported by your Society.

*See "Ethiopia Yields First 'Family' of Early Man," by Donald C. Johanson, December 1976.

The earliest hominid?

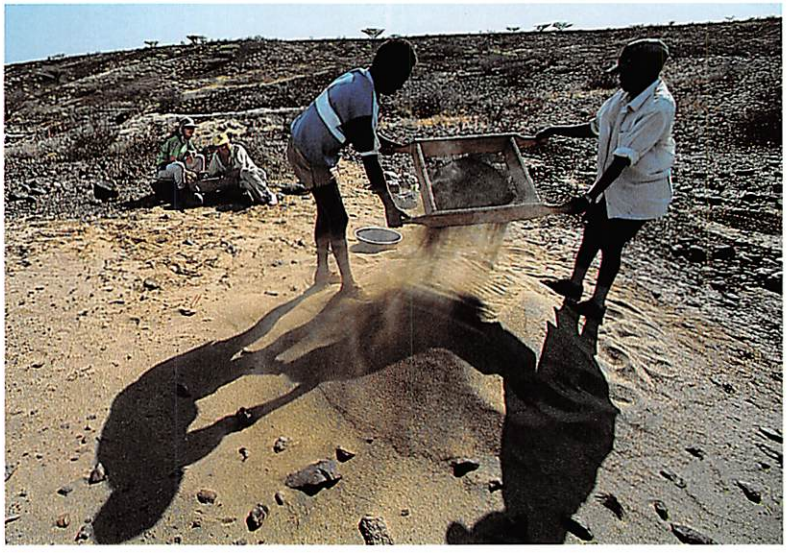
Ape, hominid, or something in between? Based on the shape of the embedded tooth, some researchers believe that a 5.6-million-year-old jaw fragment (above, at left) discovered at Lothagam in 1967 is the oldest hominid fossil yet found. Skeptics say the fragment is too meager to classify. Other finds, in the 1970s, have been identified as specimens of the early hominid *Australopithecus afarensis:* a partial skeleton called Lucy from Hadar in Ethiopia and a 3.5-million-year-old mandible from Tanzania, at right, exhumed by the author's mother-in-law, Mary Leakey. With the 1994 Turkana expedition the horizon was pushed back another 600,000 years. Meanwhile, research in Ethiopia by Tim White of the University of California, Berkeley, has uncovered even older fossils, which he has identified as a new genus, *Ardipithecus.*





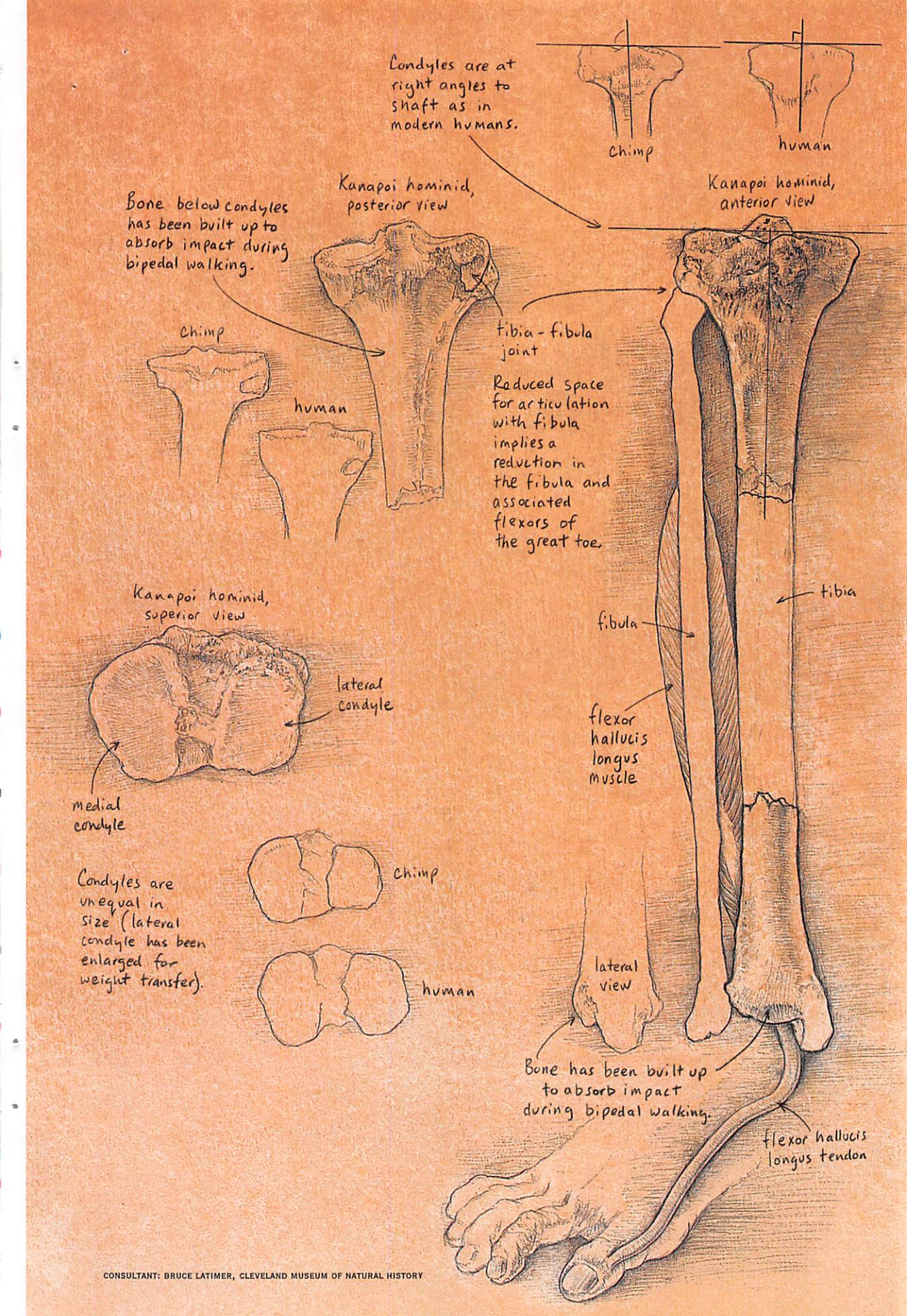
Early steps on the road to humankind

Bipedalism

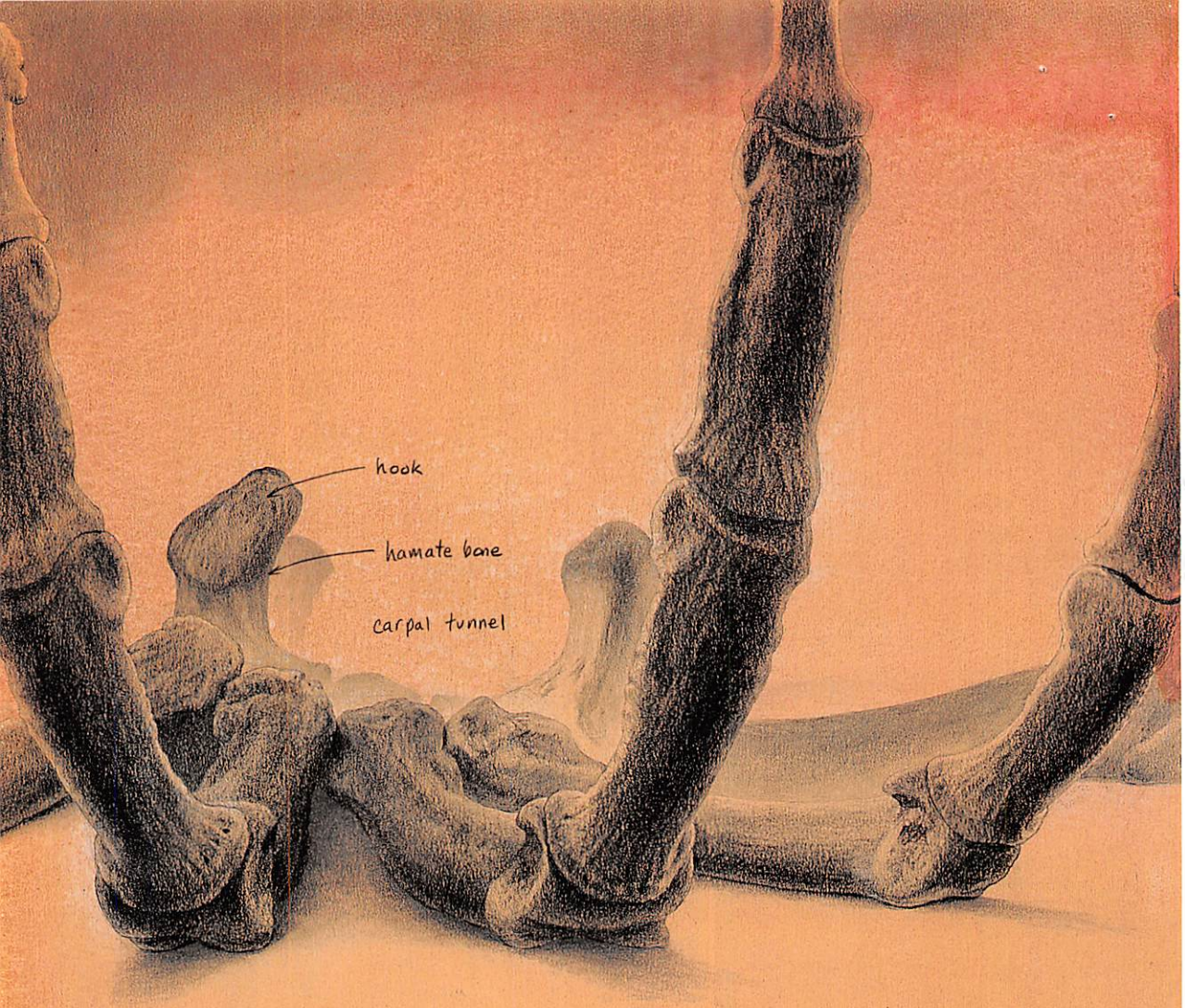


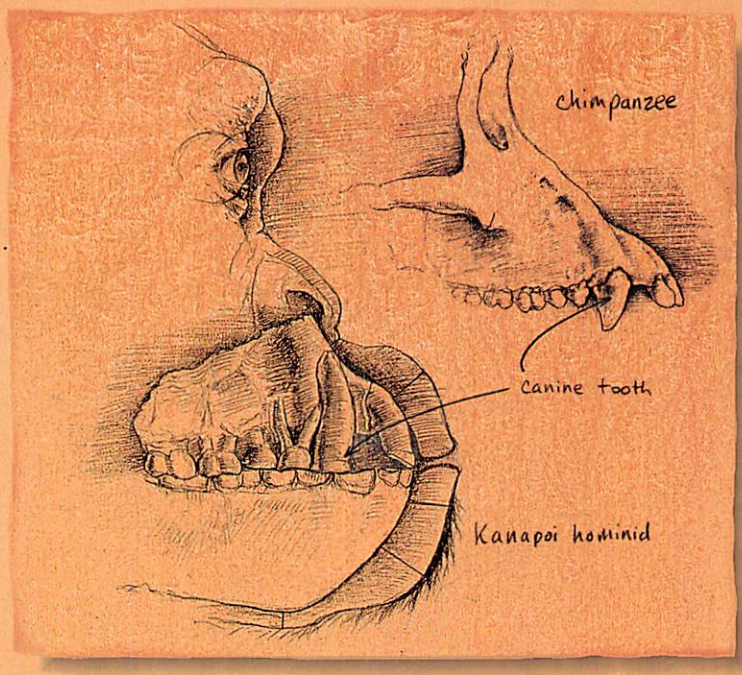
Sifting through the fossil-rich sediments at Turkana's Allia Bay site, a research team under Alan Walker (right, at rear right) of Pennsylvania State University leaves no sand unturned in the search for fossils exposed by erosion and fragmented by the elements. Though tedious, only interminable sieving can yield the tiny pieces of bone and teeth that make up a vital part of the fossil record.

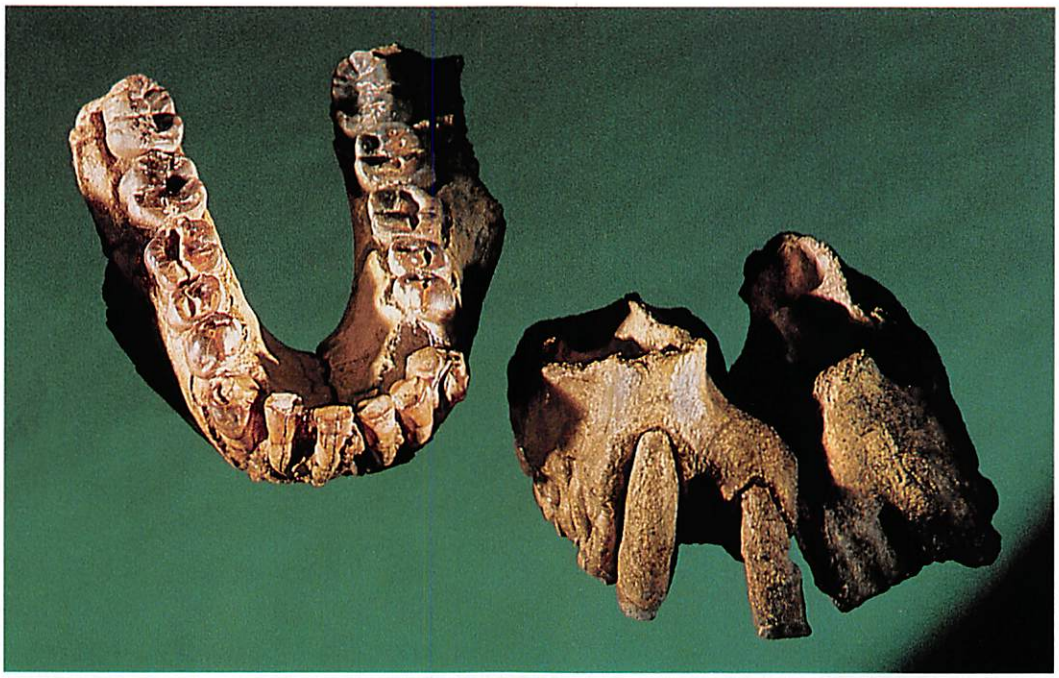
Since bipedalism is the primary factor separating apes from hominids, the Turkana researchers were particularly interested in leg bones. From the Kanapoi site, two sections of a tibia—the larger bone of the lower leg—show clearly that its owner walked upright. The socket-like condyles at the knee (top, at right) are both concave—a hominid trait; in an ape one would be convex. And a buttress of flared bone at the bottom of the tibia, at left, where it joins the ankle, is also hominid-like. A built-in shock absorber, the bone enlargement indicates an animal that bore more upright weight than an ape could. Another indication of the animal's bipedalism is the relative delicacy of the fibula implied by its small junction at the knee. Too frail to support a muscle large enough for a toe-grasping ape, the fibula might have been large enough for a hominid with toes more dexterous than a modern human's. To what extent these hominids were tree dwelling, or even tree climbing, remains a question.



CONSULTANT: BRUCE LATIMER, CLEVELAND MUSEUM OF NATURAL HISTORY


hook
hamate bone
carpal tunnel


chimpanzee
canine tooth
Kanapoi hominid

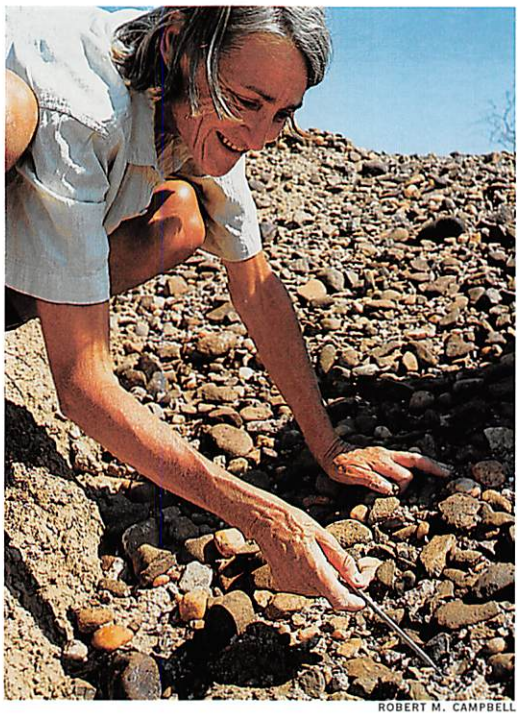


More clues to hominid development

Transitional jaw

Like a primordial grin from across the eons, a 4.1-million-year-old jawbone delights the author (right) moments after it was discovered at Kanapoi by a member of the fossil-hunting team called the Hominid Gang. Both this mandible (above, at left) and an upper jaw, or maxilla, with protruding teeth that was found nearby are significant discoveries—though a complete skeleton remains the ultimate goal. Before the 1994 season there was scant evidence of hominids older than 3.6 million years.

The Kanapoi mandible proved more "chinless" and thus more apelike than specimens of *Australopithecus afarensis.* But the teeth tell us that this primate was a hominid, not an ape. The vertically placed root of the heavily worn canine in the upper jaw (inset, facing page) is clearly more humanlike than the angled root in chimps. Such differences lead Leakey to believe that she has discovered a new species.

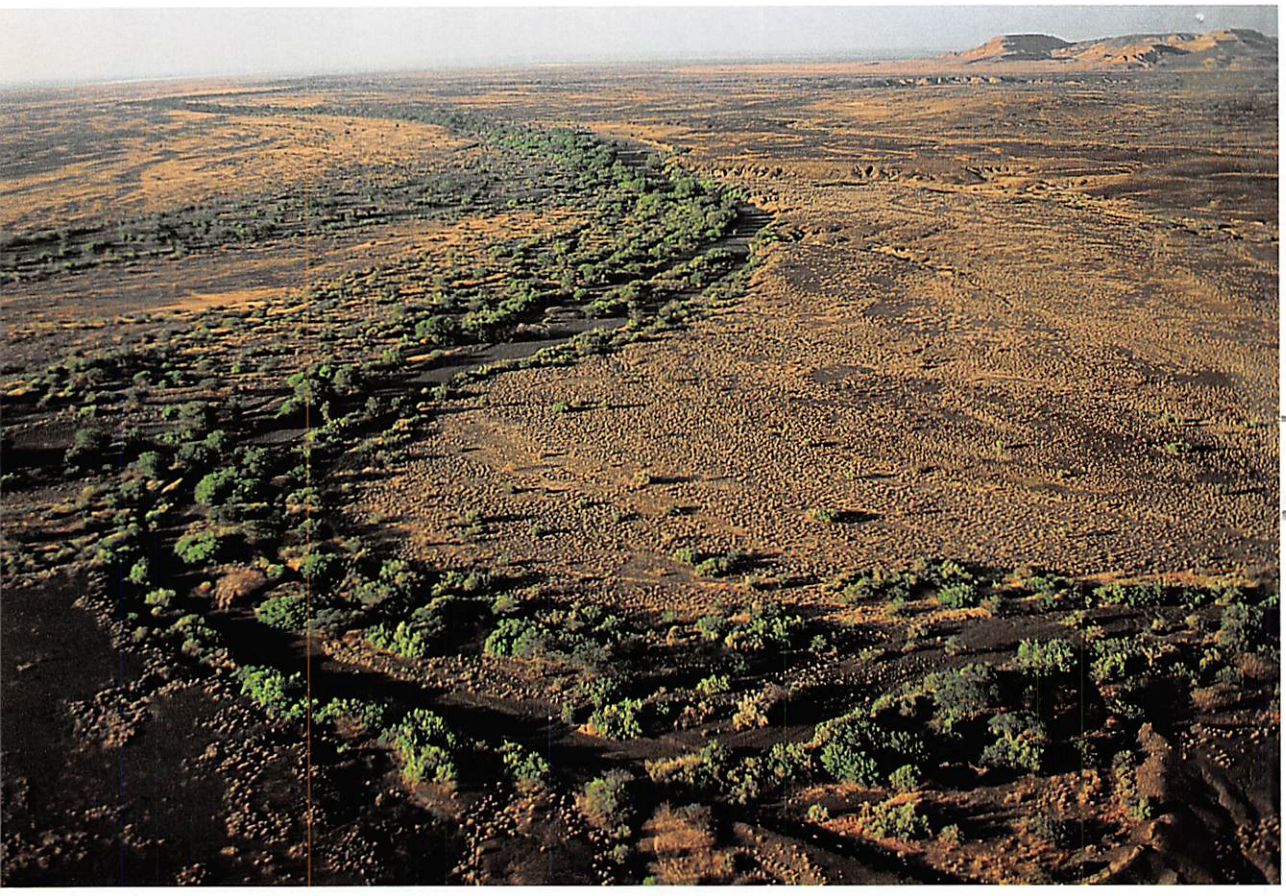


ROBERT M. CAMPBELL

Arboreal arms

Several fragments from Lake Turkana's Turkwel site turned out to be carpal bones from a hominid 3.5 million years old. One of these—a hamate bone—provides a valuable clue for inferring the creature's hand strength.

As illustrated at far left, the wrist bones form a "carpal tunnel" through which tendons pass from the arm muscles to the fingers. Because the hook of the Turkwel hamate is about twice the size of that in modern humans, Leakey reckons that the tunnel was deeper, holding larger tendons for stronger hands. This supports the thesis that early hominids were still heavily engaged in tree climbing.



We also discussed what those early hominids would have looked like. We suspected that their jaws and teeth would resemble a chimpanzee's, while below the neck they would look like later hominids, such as *A. afarensis.*

ONE DAY, while I was recording details about two pig jaws we had found, one of the Hominid Gang, Wambua Mangao, called out excitedly. I followed him to a spot where I could see five small areas of bluish tooth enamel embedded in a rock. I turned the rock over to find that it held half of the upper jaw of a hominid. It was from an animal about the size of a chimpanzee—an old individual, because the teeth were quite worn. I shook Wambua's hand enthusiastically.

A few days later Kamoya discovered the upper part of a tibia, the main bone of the lower leg. Slightly bigger than that of the largest *afarensis* yet found, its size surprised us—especially since the jaw nearby was chimp size.

Soon Kamoya, Wambua, and Samuel Ngui, another Hominid Gang member, found the lower end of the tibia. It closely resembled that of *afarensis,* strongly suggesting that this hominid was also bipedal.

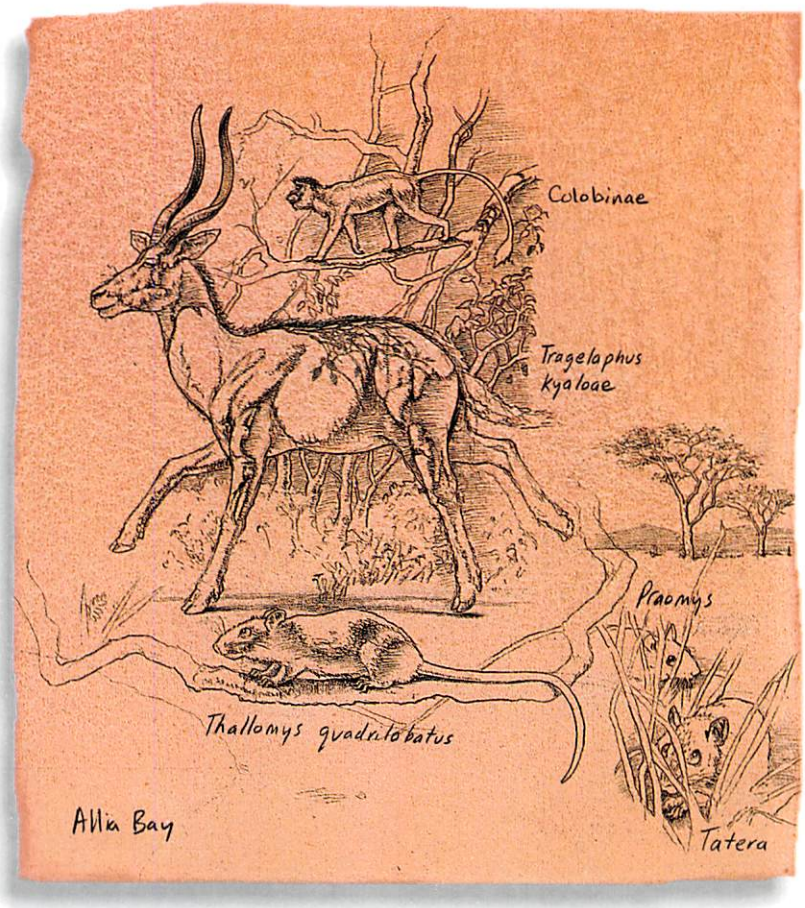
These were major discoveries, and I returned to Nairobi reluctantly—only to receive Kamoya's phone call about the teeth unearthed by Nzube. The more I studied the teeth, the more they convinced me that this animal was strikingly different from later hominids and from all known fossil apes. Indeed, it appeared that the Hominid Gang had found an altogether new species, with some features found in both chimp and *afarensis* and others that were unique.

What did this blend mean? About diet, for instance. Was the large canine for breaking nuts or hard fruits? Or was it for display or defense? Were our specimens male or female?

Back at Wambua's site we began recovering the teeth of a second, very young individual as well as the rest of the upper jaw of the first. Thus we had a complete upper jaw with most of the teeth. Now we hoped to find a

Out of the woods . . .

. . . and onto the plains: Hominids may have become bipedal as a result of their forays into unfamiliar and dangerous environments. Supporting this idea is the mosaic nature of the East African Rift, where galleries of woodland—like this one along the dry Turkwel riverbed—wind across the great savanna. That similar conditions existed here four million years ago is borne out by the fossil record. The remains of forest-dwelling monkeys, antelope, and rats were discovered at Allia Bay in sediments that also contained grassland creatures such as field rats and gerbils.



complete skull, but the season was ending.

On the last weekend Richard flew up to join us. The previous year he had lost both his legs following an airplane accident. He walks now with artificial legs, but his enthusiasm for fossils is undiminished. We were applying a protective coat of plaster to a large elephant skull found earlier. Nzube was with us, even though he was supposed to be overseeing work at another site nearby. He was enjoying having Richard around so much that he hesitated to leave his side. Finally I insisted Nzube go, and he headed off.

It was a walk he had taken often, but this time his route, or perhaps the angle of the light, might have differed slightly. A few minutes after he left, Nzube ran back, shouting in Swahili, "Come quickly. It is wonderful."

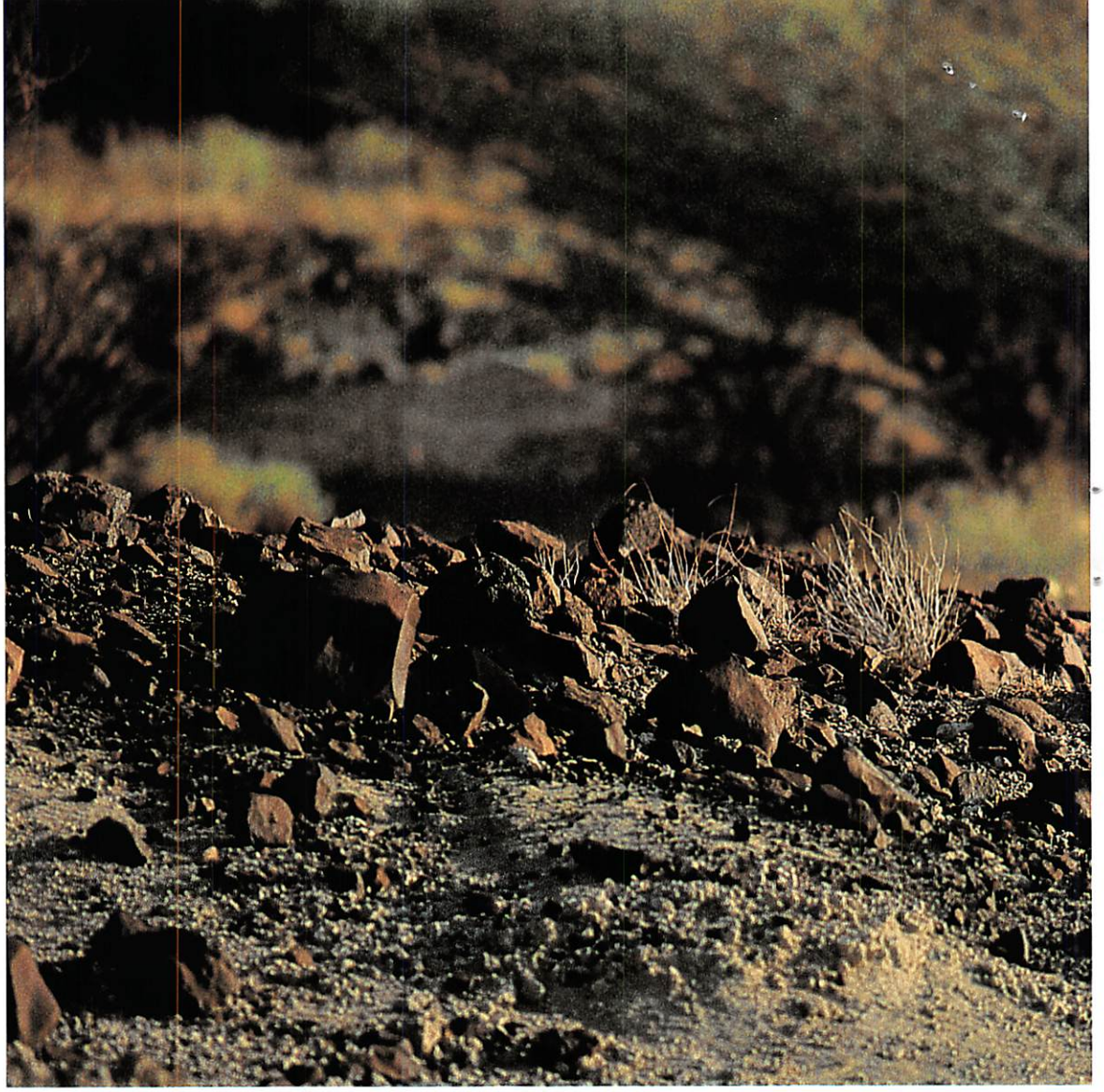
I couldn't believe what I saw sticking out of the sediment—a complete lower jaw and right next to it a piece of the ear region of a skull. I hurried back to Richard and asked him if he would excavate a hominid for me.

Nzube's new fossils resembled those we had already found that season, showing the same mixture of chimp, *A. afarensis,* and unique features. The smaller canines suggested that this individual might be female.

The part of the lower jaw that in humans forms our chins sloped sharply backward. *Afarensis*'s lower jaw slopes also, but much less so than this new individual's. Nzube almost immediately recovered a lower molar of another individual. This was the third site in which we had found the remains of more than one hominid. Perhaps they were the leftovers from some carnivore's meals.

Returning to Nairobi, I was thrilled with the finds we would report—the most complete known specimens of a hominid of this age, and almost certainly a new species older than Lucy. Moreover, we could argue convincingly that this animal was bipedal.

Then came the news that my colleague Tim White, a paleoanthropologist at the University of California, Berkeley, was also about to announce a new hominid species from a site called Aramis in Ethiopia that was even



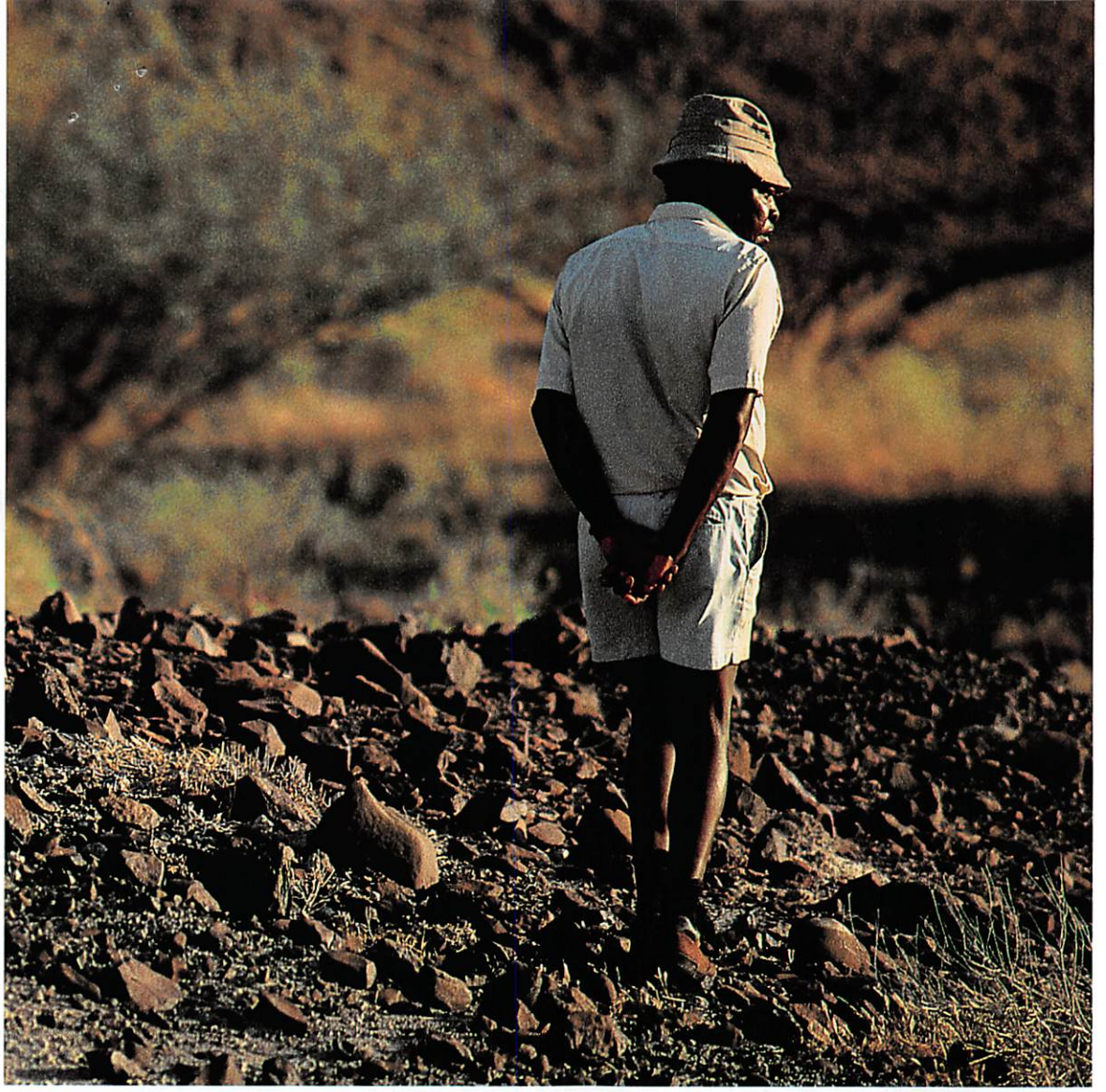
Hominid hunter

After 35 years in the field Kamoya Kimeu still displays an uncanny knack for spotting fossils. His 1984 discovery of a *Homo erectus* skull fragment led to the recovery of a nearly complete 1.6-million-year-old skeleton. The longtime leader of the Hominid Gang, Kimeu sometimes imagines that the fossils speak to him from the stones and rubble, revealing the secrets of our oldest kin.

older—4.4 million years. He had found teeth and arm bones of an animal he believed was bipedal. His descriptions and photographs indicated that it might be the same animal as we had at Kanapoi. He had tentatively named it *Australopithecus ramidus,* the species name coming from the Afar word for "root."

Tim and his Ethiopian colleague Berhane Asfaw generously invited me to Addis Ababa last January to see the Aramis fossils for myself. Tim had just returned from his latest field season with more surprises. Another of his Ethiopian collaborators, Yohannes Haile Selassie, had found a partial skeleton of *ramidus,* including the pelvis and a tibia—critical in understanding this animal's degree of bipedalism. By spring Tim would conclude that the fossils were sufficiently different from previous finds to warrant placing them in a new genus—*Ardipithecus,* or "ground ape."

Comparing the casts of bones and teeth from Tim's first discoveries with our Kanapoi



finds, my longtime colleague Alan Walker of Pennsylvania State University and I now believe that the Kanapoi teeth look more like *Australopithecus afarensis* than *Ardipithecus ramidus*. I suspect that the Kanapoi fossils may represent Lucy's ancestor and that *Ardipithecus* may belong on another branch of the hominid tree.

Many hominid species may have evolved in those early years. Bipedalism was a profound new anatomical idea, and hominids must have developed many variations on that theme, although only one survives.

After my visit to Addis Ababa I flew to Allia Bay with Alan Walker and Johns Hopkins University graduate student Katey Coffing, who was joining our crew. We planned to excavate an unusual site where thousands of bone fragments were concentrated on the banks of a river just less than four million years ago. Several years ago we found hominid teeth and a jaw fragment there. In 1988 our field crew had recovered an unidentified hominid radius, or forearm bone, not far from the site.

After my first day of prospecting, I returned tired and overheated to camp to see Kamoya beaming. I knew that smile.

"What have you got?" I demanded.

"Hominid," he said.

I laughed and hugged him. No one can find them like Kamoya.

In the days ahead we excavated his discovery—a piece of the upper jaw with a tooth. We found several more teeth nearby. They are fragments, to be sure, but they are also clues. The search continues, and slowly we will accumulate enough of them to begin to understand our oldest ancestors. □

By BILL BRYSON
Photographs by WILLIAM ALBERT ALLARD

ESSENCE OF